EFFECT OF MUSCLE LENGTHENING PROGRAM ON HAMSTRING FLEXIBILITY IN YOUNG ADULTS WITH HAMSTRING TIGHTNESS.

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KEYWORDS

HAMSTRING, healthy lifestyle, muscle-lengthening

ABSTRACT

Introduction:
Flexibility is a fundamental aspect of a healthy lifestyle, yet individuals with sedentary habits often find it increasingly challenging. Incorporating regular stretching exercises can significantly aid in alleviating hamstring tightness, a prevalent concern among young adults due to extended periods of forward-leaning sitting. However, there is limited research on the combined and long-term effects of various intervention methods. Therefore, this study aims to assess the impact of an advanced muscle-lengthening program on enhancing hamstring flexibility.
Methods:
Patients were randomly allocated into 2 groups. A random sampling technique was used to choose 104 participants with hamstring tightness for this experimental study. People of age 18-25 unable to perform active knee extension actively less than 125^0 were included. For 6 weeks, Participants in group A received phase wise advanced muscle lengthening techniques and the participants in group B received conventional

stretching technique. The Active Knee Extension Test, Forward Flexion Distance Test and Straight leg raise test were used to collect pre- and post-test data.
Results:
Comparing the pre- and post-intervention levels, the results stated that group A had extremely significant effect on hamstring flexibility in all the three outcome measures ($p < 0.0001$) than group B. There was a significantly high mean difference among the outcome measures in group A than B.
Conclusion**:**
The study revealed the remarkable efficacy of a advanced muscle lengthening program, demonstrating significantly greater improvements in hamstring flexibility compared to conventional methods in Group B. This innovative approach can facilitate the recovery of individuals with hamstring tightness by optimizing outcomes and has strong potential for integration into future rehabilitation programs.

Introduction:

The flexibility is a ability to move one or more joints freely, without constraint, and within a pain-free range [1,2]. For optimal biomechanics to function, flexibility is said to be essential [3]. Variations in flexibility can lead to abnormal strain on muscles and joints, potentially causing injuries by compromising endurance, strength, and motor coordination while inducing significant pain. The hamstrings are among the most commonly tight muscle groups [5].The hamstring muscles extend the hips and flex the knees. As so, it helps to preserve the human body's suppleness [6].

The Active Knee Extension (AKE) test results show that 82% of young people exhibit hamstring tightness.The age span of 5–12 years old to 40–49 years old is where hamstring tightness increases [7]. The most common lower limb to experience hamstring tightness is the right one [8]. Owing to their low levels of physical activity and erratic workout regimens, typical individuals are more prone to have hamstring tightness [9].The inability to extend the knee more than 160º with the hip at 90º degrees of flexion is a sign of tight hamstrings. The population included in the 18–25 age range report hamstring tightness at a rate of 27.50% and 45%, respectively [10]. They assert that most students sit with th0eir hips and knees bent at a 90 º angle, which increases the risk of hamstring strain [11].

The study population consisted Young adults, specifically those who are students and have to sit for long periods of time at work, often have tight hamstrings, college and school can also impair soft tissue flexibility, particularly in the muscles that support two joints [12]. Due to bending of the knee and posterior pelvic tilt, the hamstring muscles are held in a shortened position when seated. This prolonged shortened posture puts strain on the lumbar intervertebral disc, causes muscle tightness, and develops trigger points in muscle [13,14]. In addition, those with Hamstring tightening feel more mechanical strain on their spines when they bend ahead frequently [15]. Restricted range of motion causes hamstring tightness, injuries to the muscles, joint hypomobility, pressure on the nerves, and degenerative conditions of the disc [16,17] . An increase in either passive or active muscle tension is one major thing that can make muscles tight and limit their range of motion. Passive tension results from scarring or postural adaptation, on the other hand, active tension causes the muscle to shorten through contractions or spasms [18]. Muscle imbalances may thus result from ROM abnormalities [19]. Disruption of force couples surrounding joints may result from this. The literal meaning of a force couple is two parallel and equal forces acting in opposing directions to produce rotation [20]. As a result, changes in load and mechanical alignment brings about imbalances that impact the chain of kinetic motion. For instance, a tight hamstring shortens the abdominal muscles by pulling the same side innominate bone of the pelvis

posteriorly and so the erector spinae and hip flexors weaken and lengthen which results in pain at low back area [21].

The active knee extension range is reduced, dorsiflexion and lumbar lordosis are decreased, and postural abnormalities such as difficulty bending forward, pain during sitting, and a limping gait are caused by hamstring stress [22]. Research suggests that poor mobility, neural tension, muscular imbalances, fatigue, and a previous episode of injury are risk factors for tightness [23,24]. The primary cause of both Hamstring injury and flexibility is the tension, tightness, and immobility of the nerves [25]. The hamstring length is decreased because of restricted nerve mobility. The protective muscle contraction that occur from neural mechanical sensitivity causes hamstring tightening, which increases the chance of a strain injury [26, 2627]. As a two-joint muscle, the hamstring muscle is important for regular tasks like jogging, jumping, walking and also for controlling some trunk motion. Due to increased passive resistance during the swinging phase of the gait cycle and running, which causes more knee bending than usual and increases patellofemoral joint reaction forces, tight hamstrings can increase patellofemoral compressive loads [28].

Active Knee Extension (AKE) and Passive Straight Leg Raise (PSLR) are frequently used to assess the flexibility in hamstrings. Limitations in knee extension when the hip is flexed or of hip flexion when the knee is extended are caused by hamstring shortness [29]. Traditionally, different stretching types was used to improve flexibility. Among these, Proprioceptive Neuromuscular Facilitation (PNF) technique, Static Stretching and Active Dynamic Stretching are most preferred [30]. Neural flossing technique involves stretching and it has proven to be effective to relieve tightness, it increases hamstring flexibility and body functioning as a whole [31,32] . Hold-relax method rooted in the PNF approach, have been applied with the intention of stimulating sensory receptors that provide information about body position and movement to facilitate a desired motion [33]. Static stretching is the first ranked and preferred technique because it's easy and safe implementation for individuals. Active isolated stretching (AIS) exercises are used as one of these new techniques. This method was designed to control tendon stretching reflexes. It also promotes the functional and physiological restoration of fascial planes. Dynamic stretching exercises are also effective in short hamstring. Ballistic stretching is included in dynamic stretching and has proven to be effective [34].

Thus, this study aimed to evaluate the impact of muscle lengthening program on hamstring flexibility.

Materials and methods

This experimental study carried out at Krisha Vishwa Vidyapeeth, Karad after the receiving approval from the Institutional Ethical Committee. Participants' allowance to permit the experiment was taken through signing the consent form. A total of 117 individuals fulfilled the inclusion criteria, out of which 6 individuals did not agree to participate while the other 7 terminated the treatment. The remaining 104 individuals participated actively during the study. Following that, 104 participants were assigned into two groups at random—Group A and Group B—using a straightforward random selection technique. The study duration was a period of 12 months at Krishna Hospital in the physiotherapy outpatient department, Karad. The intervention was done for a period of 6 weeks. Patients of all genders ranging in age from 18-25 years old, People in normal health who have an Active Knee Extension (Popliteal angle) of less than 125° were included in the study. Subjects were barred with no recent hamstring injuries, who experience low back pain and People with have a lower limb fracture.

Sample size calculation: G-Power 3.1 software was the tool used to calculate the sample size. Total 104 participants took part in this research and randomly allocated into 2 groups by envelope method of random sampling i.e. Group A and Group B. Participants in group A received phase wise stretching techniques and the participants in group B received conventional stretching technique.

Procedure: All patients provided written and verbal informed consent prior to being included in this trial, and they were informed specifically about the study protocol, intervention, and benefits of the current research effort. Before the procedure written and informed consent form will be signed; purpose and methods of the research were briefed to the participants. Before the evaluation, a brief set of demographic data were collected from the participants. The Active Knee Extension Test , Forward Flexion Distance and SLR Test were used for the pre and post assessment. For six weeks, the treatment protocol had been adhered to with six sessions per week. Group A was given HMP, passive stretch, free exercises, hold & relax technique and MFR in the first 2 weeks of the treatment. NFT, active isolated stretching were added in the next 2 week. Later ballistic stretching was added in the last 2 weeks. The exercises progressed with weeks. Group B was given conventional treatment including HMP, passive stretching, free exercises and hold & relax technique.

Intervention program:

Group A

Hot moist pack (HMP)

HMP is given to the hamstrings muscles. The patient is positioned in the prone position and HMP is applied for 15 minutes at the start of the treatment.

Passive Stretching [32]

The patient is in a prone position. The therapist performed a dorsiflexion maneuver in addition to raising the leg straight. One leg received three passive hamstring stretches and the other was positioned on the therapist's leg, and the other way around. The physical therapist moved the patient's leg as high as possible for each stretch. Between each stretch 30-second rest period was given.

Free exercises

Exercises such as ankle toe movements, heel slides, straight leg raise, leg curls, isometric quadriceps and hamstring were added in the protocol. 10 repetitions of each exercises were done. 2 sets of every exercise was adviced to the patient.

Hold & Relax technique [33]

For each stretch, the investigator passively stretched the hamstrings until the subject first reported a mild stretch sensation and held that position for 7 seconds. Next, the subject maximally isometrically contracted the hamstrings for 7 seconds by attempting to push his leg back toward the table against the resistance of the investigator. After the contraction, the subject relaxed for 5 seconds. The investigator then passively stretched the muscle until a mild stretch sensation was reported. The stretch was held for another 7 seconds. This sequence was repeated 5 times on each subject in the experimental group. All stretching was performed on the right lower extremity

Myofascial Release Technique (MFR) [35]

Position of the patient: prone

Mild stroking (2–3 minutes). Hands: Fists are used to make contact. The hamstrings were lightly compressed with the fist in a proximal to distal direction for two to three minutes. Using the ulnar border as a guide, apply light pressure over the hamstring muscle using the Myofascial Release Technique (MFR) until the skin's slack was released. Five repetitions of each stroke were held for 30 seconds each session. To use as little energy as possible, the hand position was crossed. During the course of treatment, none of the subjects were permitted to stretch or do any lower limb mobility exercises

Active isolated stretching [34]

In the Active isolated stretching technique, the subject was in the supine position. The subject was asked to hold the exercise band wrapping around the sole of the subject’s foot with two hands. Then, the subject was asked to raise his/her leg as high and straight as possible with the exercise band and

contracting the quadriceps muscle as much as possible for two seconds with stretching the hamstring muscle and then relaxed. During stretching, the other extremity was fixed in full extension position

Neural flossing technique [17]

The participant actively performed the NFT while seated in a chair, flexing their knee and neck simultaneously, and maintaining the position for five seconds. In turn, each participant flexed their hip, abducted their hip slightly, and extended their neck and knee. The extended position was held for a duration of five seconds. This was done three times, with a five-minute break in between each of the three sets. Dorsiflexing the ankle and extending the foot's toes upward towards the shin enhanced the stretching impact as it became less sensitive.

Ballistic stretching [34]

Ballistic stretching is a technique that uses jerky movements to push the body beyond its natural range of motion. The stretch is held for a brief period of time to allow the muscles to bounce. In the ballistic stretching technique, in standing position, the subjects were asked to raise their legs as high as they could by repetitions their legs as flat as possible. In practice, oscillation was obtained in the hamstring muscle at two repetitions each second for one repetition.

Group B

Hot moist pack (HMP)

HMP is given to the hamstrings muscles. The patient is positioned in the prone position and HMP is applied for 15 minutes at the start of the treatment.

Passive Stretching [32]

The patient is in a prone position. The therapist performed a dorsiflexion maneuver in addition to raising the leg straight. One leg received three passive hamstring stretches of 30 second each and the other was positioned on the therapist's leg, and the other way around. The physical therapist moved the patient's leg as high as possible for each stretch. Between each stretch 30-second rest period was given.

Free exercises

Exercises such as leg ankle toe movements, leg curls, isometric quadriceps and isometric hamstrings were added in the protocol. 10 repetitions of each exercises were done. 2 sets of every exercise was adviced to the patient.

Hold & Relax technique [33]

For each stretch, the investigator passively stretched the hamstrings until the subject first reported a mild stretch sensation and held that position for 7 seconds. Next, the subject maximally isometrically contracted the hamstrings for 7 seconds by attempting to push his leg back toward the table against the resistance of the investigator. After the contraction, the subject relaxed for 5 seconds. The investigator then passively stretched the muscle until a mild stretch sensation was reported. The stretch was held for another 7 seconds. This sequence was repeated 5 times on each subject in the experimental group. All stretching was performed on the right lower extremity.

Table 1 : **Intervention**

	GROUP A	
WEEK 1 & 2	EXERCISE	DOSAGE
	HMP	15 minutes
	Passive stretching	30sec x 3 reps
	Free exercises	1 x 10(2sets)
	MFR	2-3min(30 sec hold)

	Hold & relax technique	5 times (7 sec hold)
WEEK 3 & 4	HMP	15 minutes
	Passive stretching	30sec x 3 reps
	Free exercises	1 x 10(2sets)
	MFR	2-3min(30 sec hold)
	NFT	30 sec x 3reps
	Active isolated stretching	2sec x 5 reps
	Hold & relax technique	5 times (7 sec hold)
WEEK 5 & 6	HMP	15 minutes
	Passive stretching	30sec x 3 reps
	Free exercises	1 x 10(2sets)
	MFR.	2-3min(30 sec hold)
	Active isolated stretching	2sec x 5 reps
	NFT	30 sec x 3reps
	Ballistic stretching	1 x 10reps
	Hold & relax technique	5 times (7 sec hold)
GROUP B		
WEEK 1 TO 6	EXERCISE	DOSAGE
	HMP	15 minutes
	Passive stretching	30sec x 3 reps
	Free exercises (ankle toe movements, heel slides, straight leg raise, leg curls, isometric quadriceps and hamstring)	1 x 10(2sets)
	Hold & relax technique	5 times (7 sec hold)

Table 1 shows the exercise protocol for group A and B as it progresses after every two weeks. The dosage of the exercises are also mentioned in the table.

Outcome measures:

1. Active Knee Extension Test (AKE) [17]

The patient is lying on their back. Straps are placed around the plinth and over the front of the participant's pelvis to keep the pelvis neutral during the Hamstring measurement process.
The test leg's hip was supposed to be flexed so that it touched the PVC bar.
Next, the participant was told to extend his leg as far beyond his knee as possible.
The moveable arm was then parallel with the ankle's lateral malleolus, the stationary arm with the greater trochanter parallel to the femur, and the goniometer was placed over the line of the lateral knee joint.

2. Forward Flexion Distance Test (FFD) [35]

It was used to gauge the degree and flexibility of the hamstring muscle. It was requested to the participant to stand on the box. The individual would next execute a maximal and progressive anterior trunk flexion. With the arms extended and the palms parallel to the fingers, the knees remained straight. A measuring tape was used to check the distance between the finger tips and the top of the box. Each limb's measurements were obtained independently.

3. Straight leg raise test [36]

The SLR test was performed by having the subject lie supine with both hips and knees fully extended. The contralateral lower extremity was secured to the examination plinth using a nylon strap placed over the distal thigh. A gravity inclinometer was placed on the distal leg at the level of the medial malleolus. With the ipsilateral knee fully extended, the tested extremity was passively raised to a point where the subject experienced a strong but tolerable stretch in the posterior thigh. The angle of the subject's lower extremity from the horizontal surface of the examination plinth was recorded from the inclinometer strapped to the distal tibia.

RESULTS

Table 2: Demographic Data

DEMOGRAPHIC VARIABLES		GROUP A		GROUP B	
		Number of participants	Percentage %	Number of participants	Percentage %
AGE (YEARS)	20-25 YEARS	52	50%	52	50%
BMI	18.5-24.9kg/m^2	50	48.07%	44	42.3%
GENDER	MALES	28	53.84%	30	57.69%
	FEMALES	24	46.15%	22	42.30%

According to the result in Table 2, demographic data in the form of variables was distributed. Pre- and post-assessment results indicated significant enhancements, in accordance to the results of the within-group comparison.

Table 3: Comparison of AKE test within the group A and group B (pre-post)

Active knee extension test	Right leg		Left leg	
	Group A	Group B	Group A	Group B
Pre	118.12±3.568	116.64 ±0.698	118.06±4.017	116.68 ± 0.626
Post	135.84± 5.99	117.49 ±2.671	136.59 ±6.102	117.485±2.675
Mean Difference	17.72	0.85	18.53	0.8

P value	< 0.0001	0.0011	< 0.0001	0.0022
T score	25.92	3.14	25.87	2.10

Interpretation: *Table 3* shows within group comparison of AKE Test Score. Group A pre intervention mean for right leg was 118.12 ± 3.568 and post intervention mean was 135.84± 5.99 while mean for left leg was 118.06±4.017 and post intervention was 136.59 ±6.102 with mean difference of right leg was 17.72 and left leg was 18.53 .Group B pre intervention mean for right leg was 116.64 ±0.698 and post intervention mean was117.49 ±2.671 while mean for left leg was 116.68 ± 0.626 and post intervention was 117.485±2.675 with mean difference of right leg was 0.85 and left leg was 0.8. With a p-value of less than 0.001, it demonstrates that the pre- and post-test results were highly significant for both the limbs in group A than B.

Table 4: Comparison of forward flexion distance test (cm) test within the group A and group B (pre-post)

	Group A	Group B
Pre	15.808 ±2.130	12.105 ± 0.823
Post	8.50 ± 2.740	11.634± 1.175
Mean difference	7.308	0.471
P value	<0.0001	0.011
T score	15.21	2.37

Interpretation: Table 4 compares the two groups' forward flexion distance test scores within each group. Group A pre intervention mean was 15.808±2.130 and post intervention mean was 8.50±2.740 with mean difference of 7.30. Group B pre intervention mean was 12.105±0.823and post intervention mean was 11.634± 1.175 with mean difference of 0.471. With a p value of less than 0.001, it demonstrates that there was extremely significant difference in group A than B.

Table 5: Comparison of straight leg raise test within and between the group A and B (pre-post)

	Group A	Group B
Pre	69.471 ± 9.844	69.115± 8.168
Post	86.221 ± 4.173	79.326 ± 8.964
Mean difference	16.75	11.07
P value	<0.0001	0.1646
T score	16.78	1.40
Comparison of Straight leg test between the groups (pre-post)		
GROUP	A	B
Post	86.221 ± 4.173	79.326 ± 8.964

P value	<0.0001
T score	5.02

Intrepretation: Table 5 compares the two groups' Straight leg raise test scores within each group. Group A pre intervention mean 69.471 ± 9.844 and post intervention mean was 86.221± 4.173 with mean difference of 16.75. Group B pre intervention mean was 69.115±8.168 and post intervention mean was 79.326±8.964 with mean difference of 11.07. Group A showed extremely significant difference in this outcome (p<0.0001) than B. It also shows comparison of Straight leg test Test Score between group A and group B. Post intervention mean of group A was 86.221±4.173 and post intervention mean of group B was 79.326± 8.964. It shows that on comparison of both groups the result was extremely significant with p value<0.001.

Table 6 : Comparison of AKE test between the groups (pre-post)

Active Knee Extension Test	RIGHT Leg AKE Test		LEFT Leg AKE Test	
	Group A	Group B	Group A	Group B
Post	135.84± 5.99	126.04 ±5.376	136.59 ±6.102	126.08 ±5.376
P value	<0.0001		<0.0001	
T score	8.78		9.31	

Interpretation: Table 6 compares the post AKE Test Score for both the groups. Post intervention mean of right leg AKE Test Score of group A was 135.84±5.99 and post intervention mean of group B was 126.04±5.376. Post intervention mean of right leg AKE Test of group A was 136.59±6.102 and that of group B was 126.04 ±5.376. It demonstrates that the result was highly significant (p value < 0.001) when comparing the two groups.

Table 7: Comparison of forward flexion distance test (cm) between the groups (pre-post)

GROUP	A	B
Post	8.50 ± 2.740	11.634± 1.175
P value	<0.001	
T score	7.57	

Interpretation: Table 7 shows comparison of Forward Flexion Distance Test Score of group A and group B. Post intervention mean of group A was 8.50±2.740 and post intervention mean of group B was 11.634±1.175. It shows that on comparison of both groups the result was extremely significant with p value<0.001.

DISCUSSION:

It is known that a lack of flexibility increases the risk of suffering a muscle injury particularly to the hamstring muscle. You can prevent these injuries by staying strong and flexible enough. This study aimed to check the efficacy of a phase wise stretching program against the conventional method to release hamstring tightness. The Active knee extension test, straight leg raise test and the forward bend test were used to measure the hamstring flexibility both pre and post intervention. [37]

According to James W. Youdas' research, there is no correlation between age and Hamstring muscle length, but there is a significant effect of gender on Hamstring, with women having longer hamstring length than men [38] Group A's mean BMI in this study was 22.63 + 2.758, while group B's was 21.98 + 3.282 their investigation, Gite AA and colleagues discovered BMI and flexibility correlation hat was significant. The thick fascia, a consequence of elevated BMI, was the cause of the limited ranges [39].

Various outcome measures utilized to evaluate the hamstrings tightness in young people were the Active Knee Extension Test, Straight leg raise test and the Forward Flexion Distance Test. Two groups of 104 young adults each were formed. A 6 exercise regimen was administered. 6 sessions per week was given to subjects from both the group. Group B served as the control group, receiving a programme consisting of conventional method, while Group A was the experimental group, receiving a programme consisting of various stretching techniques in phase wise manner. The outcome demonstrated more improvement in flexibility of hamstring post two weeks in group A. This is because various stretching techniques and exercises given in phases proactively lengthens tissues, reduces nerve tension, and improves movement. By putting strain on one end of the nerve and releasing it at the other, this exercise enhances nerve excursion and the mobility of the Hamstring muscles. A phase wise stretching program ensures mobility with exercises that are given and flexibility with stretching. Static and dynamic stretching techniques also helps in improving proprioception.

In a comparative analysis of nine participants, five received neural mobilisation (group 1) and the rest four received a stretching programme (group 2), each consisting of twenty sessions lasting thirty minutes, as part of Machado GF, et al.'s study on cases involving neural mobilisation and a muscular elongation programme on chronic backache. Group 1 showed improvement in this study's finger-ground test, with a mean of 15.03 cm at baseline and -0.3 cm at the end measure. Although the stretching group's improved mobility was also evident in the testing, the effect was not significant. In this study NFT is included in group A and proves to be significantly effective.

The reported success of the Neural Flossing group in this study is consistent with previously published research. The previous study also found improvement in AKE Test post treatment which is due to dynamic variation in neural pressure. Improvement in Range of knee extension and hip flexion was because of progress in Hamstring muscle length [17].

Another study determined that isolated stretching provides more instantaneous increase in passive SLR range in participants with short Hamstring syndrome than just static stretching [22]. Weppler and Magnusson postulated that rather than modifications to the mechanical characteristics of the muscle being stretched, such escalations in tissue flexibility might arise from modifications in the person's perception of stretch or pain. They adviced that rather than because of alterations in muscle structure, the point of limitation in Hamstring range may rise because the individual undergoing stretching may establish a "new stop point" for Hamstring range limitation. [41]

The outcome of static muscle stretching and warming up exercises on the dimension of the hamstrings were looked into by Volkert C. De Weijer and others over a 24-hour period. Three 30-second passive hamstring stretches were performed in a single session as part of static muscle stretching. The study found that in young, healthy subjects, three sets of 30 second passive stretches is sufficient for improving the length of the hamstring for at least 24 hours. [42]

Hamstring length increased following a static muscle stretching protocol, according to a study by Meroni and other authors, that assessed the Comparison of active stretching technique and static stretching technique on hamstring flexibility. Stretching helps the Golgi Tendon Organ, which causes autogenic inhibition of the muscle and causes it to lengthen [43] .Stretching exercises are intended to promote general neuromuscular system relaxation, according to Jari Ylinen et al. Increased muscle tone frequently results in pain from irritation of nerve endings or from increased intermuscular pressure, which slows down metabolism [44].

In this current research it was seen that group A after the treatment felt at ease and achieved flexibility after each session. But it was seen that in group B didn't see significant improvement. The study results showed an improvement in young adults with hamstring tightness,

So, This study provides us with a greater insight that phase wise exercise program are more beneficial and has more clinically effective impact on hamstring flexibility than the conventional exercise program in young adults with hamstring tightness

Limitation:

This research has a number of shortcomings, firstly the study was limited to a single area, which would have limited the findings generalizability to other contexts. The study sample exhibited heterogeneity in terms of occupation, which might have introduced variability in response to the intervention and influenced the study outcomes.

Future recommendations:

The future research has an aim to broaden the analysis's geographic reach to include multiple locations or regions. This would enhance the awareness of the intervention's effectiveness across different demographic and cultural contexts. This can be done with different age groups.

Conclusion:

The study concluded that, group A was significantly improved than group B in all the three outcome measures. The effect of advanced muscle lengthening program had significantly impacted on hamstring tightness than the control group. This will help to recover the hamstring tightness effectively and improve the patient's outcomes in future.

Ethical Considerations: The study protocol was approved on January 6, 2022 by the Committee of Ethics of the Krishna Vishwa Vidyapeeth, Krishna Institute of Medical Sciences, deemed to be university, Karad, Maharashtra (Protocol no. 043/2021-2022). Informing patient about the research and written consent was taken. The 2013 Helsinki Declaration's guiding principles were followed in the conduct of the study.

Data availability statement:

The datasets created and/or analysed in this study are not publicly accessible, but they can be obtained from the corresponding author upon justifiable request.

Author contributions: PP, SS, & AD were involved in the conceptualization, methodology, data analysis and manuscript writing. All authors have agreed and approved the final version of the manuscript.

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